

IN THE CLAIMS:

The following is a complete listing of the claims, and replaces all earlier listings and all earlier versions.

1. - 33. (Canceled)

34. (Withdrawn) A method of optimising an expression representing the layout of one or more objects, each said object having a predetermined outline, said method comprising the steps of:

dividing a space in which said outlines are defined into a plurality of regions, each said region being defined by at least one region outline substantially following at least one of said predetermined outlines or parts thereof;

CA determining a plurality of further regions depending on at least one characteristic of at least one of said regions, wherein each said further region has a corresponding compositing operation; and

forming said optimised expression from said plurality of further regions and corresponding compositing operations.

35. (Withdrawn) A method according to claim 34, wherein said plurality of further regions modifies a manner in which said expression is evaluated.

36. (Withdrawn) A method according to claim 35, wherein further operators are associated with at least one of said further regions.

37. (Canceled)

38. (Withdrawn) A method of calculating effective regions for a plurality of graphical objects, each said object having a predetermined outline, said method comprising the steps of:

dividing a space in which said outlines are defined into a plurality of active regions, each said active region being defined by at least one region outline following at least one of said predetermined outlines or parts thereof, each said active region having at least one corresponding Boolean expression; and

calculating said effective regions depending on at least one characteristic of at least one corresponding Boolean expression, wherein each said effective region has a corresponding Boolean operation.

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39. (Withdrawn) A method according to claim 38, wherein said corresponding Boolean operation is a stack operation.

40. (Withdrawn) A method according to claim 38, wherein said corresponding Boolean expression is primitive.

41. (Withdrawn) A method according to claim 38, wherein said corresponding Boolean operation has a primitive left operand.

42. (Withdrawn) A method according to claim 38, wherein said corresponding Boolean operation has a complex left operand.

43. - 68. (Canceled).

69. (Withdrawn) An apparatus for creating an image, said image to be formed by compositing at least a plurality of graphical objects, each said object having a predetermined outline, said apparatus comprising:

means for determining an expression for each of a plurality of active regions, each said active region being defined by at least one region outline following at least one of said predetermined outlines or parts thereof;

means for determining expressions representing each of a plurality of effective regions depending on at least one characteristic of at least one active region, wherein each said effective region has a corresponding compositing operation; and

means for applying said corresponding compositing operations substantially to said effective regions to create said image.

70. (Withdrawn) An apparatus according to claim 69, wherein a further region is determined on the basis that a particular region corresponds to a primitive expression.

71. (Withdrawn) An apparatus according to claim 69, wherein an effective region is determined on the basis that a particular active region corresponds to a primitive expression.

72. (Withdrawn) An apparatus according to claim 70, wherein said further region is an effective region.

73. (Withdrawn) An apparatus according to claim 72, wherein said effective region is equal to the intersection of the clip and active regions of said particular corresponding compositing expression.

74. (Withdrawn) An apparatus according to claim 70, wherein a level comprising a push operation is added to said compositing table.

75. (Withdrawn) An apparatus according to claim 70, wherein a corresponding compositing expression of said further region is complex.

76. (Withdrawn) An apparatus according to claim 75, wherein a level comprising a clip operation is added to said compositing table.

77. (Withdrawn) An apparatus according to claim 70, wherein a further region is determined on the basis that said corresponding compositing operation has a complex left operand.

78. (Withdrawn) An apparatus according to claim 70, wherein a level comprising a pop operation is added to said compositing table.

79. (Withdrawn) An apparatus according to claim 78, wherein said pop operation will remove any unused pixel being outside a further region representing said complex left operand, during compositing of said complex left operand.

80. (Withdrawn) An apparatus according to claim 79, wherein said further region is the active region of said complex left operand.

C1 81. (Withdrawn) An apparatus according to claim 79, wherein said further region is transformed to a still further region by said pop operation.

82. (Withdrawn) An apparatus according to claim 81, wherein said still further region is the effective region of said complex left operand.

83. (Withdrawn) An apparatus according to claim 82, wherein said still further region corresponds to a complex expression.

84. (Withdrawn) An apparatus according to claim 82, wherein a level comprising a clip operation is added to said compositing table.

85. (Withdrawn) An apparatus according to claim 70, wherein a further region is determined on the basis that said corresponding compositing operation has a primitive left operand.

86. (Withdrawn) An apparatus according to claim 70, wherein a level comprising an operation and a data fill value of a particular object constituting said further region, is added to said compositing table.

87. (Withdrawn) An apparatus according 85, wherein said further region corresponds to a complex expression.

88. (Withdrawn) An apparatus according to claim 87, wherein a level comprising a clip operation is added to said compositing table.

89. (Withdrawn) An apparatus according to claims 88, wherein a level comprising a push operation is added to said compositing table.

90. (Withdrawn) An apparatus according to claim 70, wherein said compositing table is optimised in regard to the number of pixel operations required to render said image.

91. (Withdrawn) An apparatus according to claim 70, wherein a corresponding compositing expression is a hierarchically structured representation of a particular region represented by said corresponding compositing expression.

92. (Withdrawn) An apparatus according to claim 91, wherein said mapping comprises modifying a manner in which said corresponding compositing expression is evaluated without modifying said hierarchically structured representation.

93. (Withdrawn) An apparatus according to claim 70, wherein said image is at least in part a pixel based image.

C 94. (Withdrawn) An apparatus according to claim 70, wherein a wholly opaque object in a particular region acts to eliminate one or more operations contributing to at least one other object constituting said particular region, wherein said at least one other object is obscured by said wholly opaque object in a space in which said outlines are defined.

95. (Withdrawn) An apparatus for creating an image, said image to be formed by compositing at least a plurality of graphical objects, each said object having a predetermined outline, said apparatus comprising:

division means for dividing a space in which said outlines are defined into a plurality of regions, each said region being defined by at least one region outline following at least one of said predetermined outlines or parts thereof;

processor means for determining a plurality of further regions depending on at least one characteristic of at least one region, wherein each said further region has a corresponding compositing operation;

mapping means for mapping said further regions and corresponding compositing operations into a compositing table, comprising a plurality of levels, wherein each said level of said compositing table represents at least one operation for rendering an object or parts thereof or represents an outline for clipping at least one other level; and

compositing means for compositing said image using said compositing table.

96. (Withdrawn) An apparatus according to claim 95, wherein a further region is determined on the basis that a particular region corresponds to a primitive expression.

97. (Withdrawn) An apparatus according to claim 95, wherein an effective region is determined on the basis that a particular active region corresponds to a primitive expression.

98. (Withdrawn) An apparatus according to claim 95, wherein said further region is an effective region.

99. (Withdrawn) An apparatus according to claim 98, wherein said effective region is equal to the intersection of the clip and active regions of said particular corresponding compositing expression.

100. (Withdrawn) An apparatus according to claim 98, wherein a level comprising a push operation is added to said compositing table.

101. (Withdrawn) An apparatus according to claim 95, wherein a corresponding compositing expression of said further region is complex.

CI 102. (Withdrawn) An apparatus according to claim 101 wherein a level comprising a clip operation is added to said compositing table.

103. (Withdrawn) An apparatus according to claim 95 wherein a further region is determined on the basis that said corresponding compositing operation has a complex left operand.

104. (Withdrawn) An apparatus according to claim 103, wherein a level comprising a pop operation is added to said compositing table.

105. (Withdrawn) An apparatus according to claim 104, wherein said pop operation will remove any unused pixel being outside a further region representing said complex left operand, during compositing of said complex left operand.

106. (Withdrawn) An apparatus according to claim 105, wherein said further region is the active region of said complex left operand.

107. (Withdrawn) An apparatus according to claim 105, wherein said further region is transformed to a still further region by said pop operation.

108. (Withdrawn) An apparatus according to claim 107, wherein said still further region is the effective region of said complex left operand.

109. (Withdrawn) An apparatus according to claim 107, wherein said still further region corresponds to a complex expression.

CI 110. (Withdrawn) An apparatus according to claim 109, wherein a level comprising a clip operation is added to said compositing table.

111. (Withdrawn) An apparatus according to claim 95, wherein a further region is determined on the basis that said corresponding compositing operation has a primitive left operand.

112. (Withdrawn) An apparatus according to claim 96, wherein a level comprising an operation and a data fill value of a particular object constituting said further region, is added to said compositing table.

113. (Withdrawn) An apparatus according to claim 111, wherein said further region corresponds to a complex expression.

114. (Withdrawn) An apparatus according to claim 113, wherein a level comprising a clip operation is added to said compositing table.

115. (Withdrawn) An apparatus according to claim 111, wherein a level comprising a push operation is added to said compositing table.

116. (Withdrawn) An apparatus according to claim 95, wherein said compositing table is optimised in regard to the number of pixel operations required to render said image.

117. (Withdrawn) An apparatus according to claim 95, wherein a corresponding compositing expression is a hierarchically structured representation of a particular region represented by said corresponding compositing expression.

118. (Withdrawn) An apparatus according to claim 117, wherein said mapping comprises modifying a manner in which said corresponding compositing expression is evaluated without modifying said hierarchically structured representation.

119. (Withdrawn) An apparatus according to claim 95, wherein said image is at least in part a pixel based image.

120. (Withdrawn) An apparatus according to claim 96, wherein a wholly opaque object in a particular region acts to eliminate one or more operations contributing to at least one other object constituting said particular region, wherein said at least one other object is obscured by said wholly opaque object in a space in which said outlines are defined.

121. (Withdrawn) A computer readable medium for storing a program for apparatus which processes graphical objects intended to form a raster pixel image, said processing comprising a method of creating an image, said image to be formed by compositing at least a plurality of graphical objects, each said object having a predetermined outline, said method program comprising:

code for determining an expression for each of a plurality of active regions, each said active region being defined by at least one region outline following at least one of said predetermined outlines or parts thereof;

code for determining expressions representing each of a plurality of effective regions depending on at least one characteristic of at least one active region, wherein each said effective region has a corresponding compositing operation; and

code for applying said corresponding compositing operations substantially to said effective regions to create said image.

122. (Withdrawn) A computer readable medium for storing a program for apparatus which processes graphical objects intended to form a raster pixel image, said processing comprising a method of creating an image, said image to be formed by

compositing at least a plurality of graphical objects, each said object having a predetermined outline, said program comprising:

code for dividing a space in which said outlines are defined into a plurality of regions, each said region being defined by at least one region outline following at least one of said predetermined outlines or parts thereof;

code for determining a plurality of further regions depending on at least one characteristic of at least one region, wherein each said further region has a corresponding compositing operation;

code for mapping said further regions and corresponding compositing operations into a compositing table, comprising a plurality of levels, wherein each said level of said compositing table represents at least one operation for rendering an object or parts thereof or represents an outline for clipping at least one other level; and

code for compositing said image using said compositing table.

123. - 128. (Canceled)

129. (New) A method of creating an image, the image to be formed by rendering a plurality of graphical objects to be composited according to one or more compositing operations, each graphical object having a predetermined object outline, each of the compositing operations being at least defined by one or more operands, each operand representing one of the graphical objects or a result of another of the compositing operations, said method comprising the steps of:

determining an active region for each of the graphical objects, each of the active regions being defined by at least one active region outline comprising at least a portion of one of the predetermined object outlines or parts thereof, such that the active region of a particular operand is wholly within the particular graphical object;

determining an active region for each of the compositing operations, said the active region for a particular compositing operation being equal to the intersection of the active regions of each operand of the particular compositing operation;

determining a clip region for each of the compositing operations, the clip region for a particular compositing operation being equal to the intersection of the active region of the particular compositing operation and the clip region of a parent compositing operation the particular compositing operation;

Q determining an effective region for each of the compositing operations the effective region for a particular compositing operation being equal to the intersection of the clip region of the particular compositing operation and the active regions associated with the operands of the particular compositing operation; and

applying the compositing operations to said the effective regions to create the image.

130. (New) A method according to claim 129, wherein each clip region is dependent upon an active region of an operand of a particular compositing operation.

131. (New) A method according to claim 129, wherein the image is at least in part a pixel-based image.

132. (New) A method according to claim 129, wherein a wholly opaque object in a particular region acts to eliminate one or more compositing operations contributing to at least one other object constituting the particular region, wherein the at least one other object is obscured by the wholly opaque object in a space in which the outlines are defined.

133. (New) A method of creating an image, the image to be formed by rendering a plurality of graphical objects to be composited according to one or more compositing operations, each graphical object having a predetermined object outline, each compositing operation being at least defined by one or more operands, each operand representing one of the graphical objects or a result of another of the compositing operations, said method comprising the steps of:

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determining an active region corresponding to each of the graphical objects, each of the active region being defined by at least one active region outline comprising a portion of one of the predetermined object outlines or parts thereof, such that the active region of a particular operand is wholly within the particular graphical object;

determining an active region for each of the compositing operations, the active region for a particular compositing operation being equal to the intersection of the active regions of each operand of the particular compositing operation;

determining a clip region for the compositing operations, the clip region for a particular compositing operation being equal to the intersection of the active region of the particular compositing operation and the clip region of a parent compositing operation the particular compositing operation;

determining a plurality of effective regions for each of the compositing operations, the effective region for a particular compositing operation being equal to the intersection of the clip region of the particular compositing operation and active regions of the particular compositing operation;

mapping the effective regions and corresponding compositing operations into a compositing table, comprising a plurality of levels, wherein each level of the compositing table represents at least one of the operators or represents an outline for clipping at least one other level; and

compositing the image using the compositing table.

134. (New) A method according to claim 133, wherein each of the clip regions is dependent upon an active region of an operand of a particular compositing operation,.

135. (New) A method according to claim 133, wherein a level comprising a push operation is added to the compositing table.

136. (New) A method according to claim 133, wherein a corresponding compositing expression corresponding to an active region is complex.

137. (New) A method according to claim 133, wherein a level comprising a clip operation is added to the compositing table.

138. (New) A method according to claim 133, wherein an active region is determined on the basis that the corresponding compositing operation has a complex left operand.

139. (New) A method according to claim 138, wherein a level comprising a pop operation is added to the compositing table.

140. (New) A method according to claim 139, wherein the pop operation will remove any unused pixel being outside an active region representing the complex left operand, during compositing of the complex left operand.

141. (New) A method according to claim 140, wherein the active region is the active region of the complex left operand.

142. (New) A method according to claim 140, wherein the active region is transformed to an effective region by the pop operation.

143. (New) A method according to claim 142, wherein the effective region is the effective region of the complex left operand.

144. (New) A method according to claim 143, wherein the effective region corresponds to a complex expression.

145. (New) A method according to claim 144, wherein a level comprising a clip operation is added to the compositing table.

146. (New) A method according to claim 133, wherein an active region is determined on the basis that the corresponding compositing operation has a primitive left operand.

147. (New) A method according to claim 133, wherein a level comprising an operation and a data fill value of a particular object constituting an active region, is added to the compositing table.

148. (New) A method according to claim 145, wherein the active region corresponds to a complex expression.

149. (New) A method according to claim 147, wherein a level comprising a clip operation is added to the compositing table.

150. (New) A method according to claim 145, wherein a level comprising a push operation is added to the compositing table.

151. (New) A method according to claim 133, wherein the compositing table is optimised in regard to the number of pixel operations required to render the image.

152. (New) A method according to claim 133, wherein a corresponding compositing expression is a hierarchically structured representation of a particular region represented by the corresponding compositing expression.

153. (New) A method according to claim 152, wherein the mapping comprises modifying a manner in which the corresponding compositing expression is evaluated without modifying the hierarchically structured representation.

154. (New) A method according to claim 133, wherein the image is at least in part a pixel-based image.

155. (New) A method according to claim 133, wherein a wholly opaque object in a particular region acts to eliminate one or more compositing operations contributing to at least one other object constituting the particular region, wherein the at least one other object is obscured by the wholly opaque object in a space in which the outlines are defined.

156. (New) A method of creating an image, the image to be formed by rendering a plurality of graphical objects to be composited according to a hierarchically structured compositing expression, each of the graphical objects having a predetermined object outline, such that an object region formed by a particular object outline of a particular graphical object is wholly within the particular graphical object, the hierarchically structured compositing expression, each compositing operation being

defined by at least one compositing operator and one or more operands, each of the operands representing one of the graphical objects or a sub-expression representing the result of another of the compositing operations, said method comprising the steps of:

determining an active region for at least each sub-expression of the hierarchically structured compositing expression, each active region comprising at least one active region outline, each of the active region outlines comprising at least a portion of one or more of the predetermined object outlines of at least one graphical object associated with a corresponding sub-expression and being dependent on the operators contained in said each sub-expression, such that the active region of a particular sub-expression is formed wholly by one or more of the object regions of graphical objects associated with the particular sub-expression;

determining a clip region for the sub-expressions, the clip region for a particular sub-expression being equal to the intersection of the active region of the particular sub-expression and the clip region of a parent compositing operation of the particular sub-expression;

determining an effective region for each of the compositing operations of the hierarchically structured compositing expression, the effective region for a particular compositing operation being equal to the intersection of the clip region of the particular compositing operation and the active regions of the particular compositing operation;

mapping each the effective region and corresponding compositing operation into a compositing table, comprising a plurality of levels, wherein each level of the compositing table represents at least one of the operators or represents an outline for clipping at least one other level; and

evaluating the hierarchically structured compositing expression using the compositing table.

157. (New) The method according to claim 156, wherein said active regions are determined during an upward traversal of the hierarchically structured compositing expression and the clip regions are determined in a downward traversal of the hierarchically structured compositing expression.

C | 158. (New) A method of creating an image, the image to be formed by compositing at least a plurality of graphical objects according to one or more compositing operations, each graphical object having a predetermined object outline, each compositing operation being defined by at least one compositing operator and one or more operands, each of the operands representing one of the graphical objects or a result of another of the compositing operations, said method comprising the steps of:

determining an active region for each of the graphical objects, each active region being defined by at least one active region outline, each active region outline comprising at least a portion of one of the predetermined object outlines or parts thereof, such that the active region of a particular operand is wholly within the particular graphical object;

determining an active region for each of the compositing operations, the active region for a particular compositing operation being equal to the intersection of the active regions associated with each operand of the particular compositing operation;

determining an effective region for each of the compositing operations wherein the effective region for a particular compositing operation being equal to the intersection of a clip region of the particular compositing expression and one or more of the active regions of the operands of the particular compositing operation, the clip region for a particular compositing operation being equal to the intersection of the active regions of the particular compositing operation and the clip region of a parent compositing operation;

mapping the effective regions and corresponding compositing operations into a compositing table, comprising a plurality of levels, wherein each level of the compositing table represents at least one of the operators or an outline for clipping at least one other level; and

compositing the image using the compositing table.

159. (New) A method according to claim 158, wherein each of the clip regions is dependent upon an active region of an operand of a particular compositing operation.

160. (New) A method according to claim 158, wherein a level comprising a push operation is added to the compositing table.

161. (New) A method according to claim 158, wherein a corresponding compositing expression corresponding to an active region is complex.

162. (New) A method according to claim 158, wherein a level comprising a clip operation is added to the compositing table.

163. (New) A method according to claim 158, wherein an active region is determined on the basis that the corresponding compositing operation has a complex left operand.

164. (New) A method according to claim 163, wherein a level comprising a pop operation is added to the compositing table.

C/ 165. (New) A method according to claim 164, wherein the pop operation will remove any unused pixel being outside an active region representing the complex left operand, during compositing of the complex left operand.

166. (New) A method according to claim 165, wherein the active region is the active region of the complex left operand.

167. (New) A method according to claim 165, wherein the active region is transformed to a still further region by the pop operation.

168. (New) A method according to claim 167, wherein the effective region is the effective region of the complex left operand.

169. (New) A method according to claim 168, wherein the effective region corresponds to a complex expression.

170. (New) A method according to claim 169, wherein a level comprising a clip operation is added to the compositing table.

171. (New) A method according to claim 158, wherein a further active region is determined on the basis that the corresponding compositing operation has a primitive left operand.

01 172. (New) A method according to claim 158, wherein a level comprising an operation and a data fill value of a particular object constituting an active region, is added to the compositing table.

173. (New) A method according to claim 171, wherein the region corresponds to a complex expression.

174. (New) A method according to claim 173, wherein a level comprising a clip operation is added to the compositing table.

175. (New) A method according to claim 171, wherein a level comprising a push operation is added to the compositing table.

176. (New) A method according to claim 158, wherein the compositing table is optimised in regard to the number of pixel operations required to render the image.

177. (New) A method according to claim 158, wherein a corresponding compositing expression is a hierarchically structured representation of a particular region represented by the corresponding compositing expression.

178. (New) A method according to claim 177, wherein the mapping comprises modifying a manner in which the corresponding compositing expression is evaluated without modifying the hierarchically structured representation.


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179. (New) A method according to claim 158, wherein the image is at least in part a pixel-based image.

180. (New) A method according to claim 158, wherein a wholly opaque object in a particular region acts to eliminate one or more compositing operations contributing to at least one other object constituting the particular region, wherein the at least one other object is obscured by the wholly opaque object in a space in which the outlines are defined.

181. (New) A method of creating an image, the image to be formed by rendering a plurality of graphical objects to be composited according to a hierarchical structure representing a compositing expression for the image, the hierarchical structure

including a plurality of nodes, each node being associated with either a compositing operator or an operand of the compositing expression, each operand representing one of the graphical objects or a result of a sub-expression of the compositing expression, each of the graphical objects having a predetermined object outline, said method comprising the steps of:

determining an active region for at least each sub-expression of the compositing expression, each of the active regions being defined by at least one active region outline, each of the active region outlines comprising at least a portion of one of the predetermined object outlines or parts thereof, such that the active region of a particular sub-expression is wholly within a graphical object being represented by the particular sub-expression;

 determining an active region for at least each sub-expression of the compositing expression, the active region for a particular sub-expression being equal to the intersection of all active regions associated with further sub-expressions containing the particular sub-expression;

determining a clip region for the sub-expressions, the clip region for a particular sub-expression being equal to the intersection of the active region of the particular sub-expression and the clip region of a parent compositing operation of the particular sub-expression;

determining an effective region for each of the nodes, each of the effective regions having a corresponding compositing operation, the effective region for a particular node being equal to the intersection of the clip regions and the active regions associated with the particular node; and

applying the corresponding compositing operations substantially to the effective regions to create the image.

182. (New) The method according to claim 181, said method further including the steps of:

mapping the effective regions and the compositing operations into a compositing table comprising a plurality of levels, wherein each the level represents at least one compositing operation for rendering an object or parts thereof or represents an outline for clipping at least one other level; and

compositing the image using the compositing table.


183. (New) The method according to claim 181, wherein the compositing operations include compositing and stack operations.

184. (New) A computer readable medium storing a program for apparatus which processes graphical objects intended to form a raster pixel image, the processing comprising a method of creating an image, the image to be formed by rendering at least a plurality of graphical objects to be composited according to a hierarchical structure representing a compositing expression for the image, the hierarchical structure including a plurality of nodes, each node being associated with either a compositing operator or an operand of the compositing expression, each of the operands representing one of the graphical objects or a result of a sub-expression of the compositing expression,

each of the graphical objects having a predetermined object outline, said program comprising:

code for determining an active region for at least each sub-expression of the compositing expression, each of the active regions being defined by at least one active region outline, each of the active region outlines comprising at least a portion of one of the predetermined object outlines or parts thereof, such that the active region of a particular sub-expression is wholly within a graphical object being represented by the particular sub-expression;

code for determining a further active region for each sub-expression of the compositing expression, the active region for a particular sub-expression being equal to the intersection of all active regions associated with further sub-expressions containing the particular sub-expression;



code for determining a clip region for each of the subexpressions, the clip region for a particular sub-expression being equal to the intersection of the active region of the particular sub-expression and the clip region of a parent compositing operation of the particular sub-expression;

code for determining an effective region for each of the nodes, each of the effective regions having a corresponding compositing operation, the effective region for a particular node being equal to the intersection of the clip regions and the active regions associated with the particular node; and

code for applying the corresponding compositing operations substantially to the effective regions to create the image.

185. (New) The computer readable medium according to claim 184, said medium further storing:

code for mapping the effective regions and the compositing operations into a compositing table comprising a plurality of levels, wherein each the level represents at least one compositing operation for rendering an object or parts thereof or represents an outline for clipping at least one other level; and

code for compositing the image using the compositing table.

186. (New) The computer readable medium according to claim 184, wherein the compositing operations include compositing and stack operations.